

Unit 12: Setting out Processes in Construction and Civil Engineering

NQF Level 3: BTEC National

Guided learning hours: 60

Unit abstract

Setting out is the process by which information is taken from the construction design drawings, and pegs, profiles or other marks are then set to control the construction works and ensure that each element of the works is constructed in the right position and to the correct level.

Learners will work with traditional methods to achieve an understanding of the essential mathematical and practical skills required for the Setting out process, including the application of basic principles of techniques to ensure appropriate levels of accuracy. The use of modern electronic instruments and awareness of emerging technology will also be addressed.

Construction projects are normally designed on a coordinate grid and calculations are carried out to convert these into a form useful for setting out. Learners must attain a reasonable standard of arithmetic and trigonometry in order to successfully complete this unit. Spreadsheets and dedicated software play an important role in reducing the calculation load for the engineer.

This is essentially a practical unit, through which learners will come to understand setting out as a key part of the construction process, and be able to carry out the standard tasks and calculations involved.

Learning outcomes

On completion of this unit a learner should:

- 1 Be able to establish grids of levels over a site and use them to establish contours and carry out volume calculations
- 2 Be able to set out construction works in plan to appropriate accuracies
- 3 Be able to control the level and gradient of construction works
- 4 Understand the uses and advantages of emerging technology in setting out.

Unit content

- 1 Be able to establish grids of levels over a site and use them to establish contours and carry out volume calculations**
Contours: interpolated and calculated from spot heights
Volumes: simple calculations from grids of levels

- 2 Be able to set out construction works in plan from coordinates to appropriate accuracies**
Works: buildings; manholes; roads

- 3 Be able to control the level and gradient of construction works**
Works: drainage runs; first and second stage earthworks

- 4 Understand the uses and advantages of emerging technology in setting out**
Emerging technology: lasers; global positioning system (GPS); digital levels; machine guidance; automated total stations

Grading grid

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all of the learning outcomes for the unit. The criteria for a pass grade describe the level of achievement required to pass this unit.

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 carry out fieldwork to establish grids of levels and contours over a site	M1 carry out volume calculations from survey measurements	D1 analyse procedures in terms of accuracy
P2 carry out fieldwork to set out works in plan from coordinates to appropriate accuracies	M2 understand the need for meeting specified accuracies in setting out	
P3 carry out fieldwork to control level and gradient		
P4 demonstrate an awareness of emerging technology in setting out processes.	M3 specify appropriate instruments and techniques for setting out tasks.	D2 assess the advantages of using digital data and new technologies in setting out processes.

Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use a wide range of techniques. Lectures and supervised practical work will predominate, but the use of personal and/or industrial experience should not be ignored. Delivery should stimulate, motivate, educate and enthuse learners. Visiting expert speakers could add to the relevance of the subject for learners. However, as mentioned above, this is essentially a practical unit and learners would benefit from hands on activities.

The learning outcomes are not linked to each other but there is a natural progression through grid levelling, setting out works in plan and controlling level and gradient. Learning outcomes 1, 2 and 3 are essentially practical. Learning outcome 4 is of a less practical nature but it gives learners the opportunity to investigate new technologies and relate their use to the practical work they have already carried out.

The unit gives learners opportunities to carry out realistic setting out tasks and produce high quality results. This unit is likely to be delivered later in the programme, since a familiarity with the use of surveying equipment and an understanding of basic levelling and angle calculations is assumed.

Group activities are permissible, but tutors will need to ensure that individual learners are provided with equal experiential and assessment opportunities.

Health, safety and welfare issues are paramount and should be strictly reinforced through close supervision of all workshops and activity areas, and risk assessments must be undertaken prior to practical activities. Centres are advised to read the *Delivery approach* section on page 24, and *Annexe G: Provision and Use of Work Equipment Regulations 1998 (PUWER)*.

Assessment

Evidence for this unit may be gathered from a variety of sources, including well-planned investigative assignments, case studies or reports of practical assignments.

There are many suitable forms of assessment that could be employed. Some examples of possible assessment approaches are suggested below. However, these are not intended to be prescriptive or restrictive, and are provided as an illustration of the alternative forms of assessment evidence that would be acceptable. General guidance on the design of suitable assignments is available on page 19 of this specification.

Some criteria can be assessed directly by the tutor during practical activities. If this approach is used then suitable evidence would be observation records or witness statements. Guidance on the use of these is provided on the Edexcel website.

The structure of the unit suggests that the grading criteria may be fully addressed by using assignments. The first of these would cover grading criteria P1, P2, P3, M1, M2 and D1, and the second would cover grading criteria P4, M3 and D2.

To achieve a pass grade learners must meet the four pass criteria listed in the grading grid.

For P1, learners must carry out fieldwork to establish grids of levels and contours over a site. They are required to calculate the results and produce a contoured drawing to a reasonable standard of neatness and accuracy. It is acceptable for this drawing to be produced either manually or by computer aided design (CAD). However, all learners should have an understanding of the calculations involved in interpolating contours.

For P2, learners must carry out fieldwork to set out works in plan from coordinates to appropriate accuracies. They are required to calculate rectangular to polar coordinates for setting out from coordinates and participate in the fieldwork for at least two tasks which need different standards of accuracy. Examples would be the setting out of building corners and of manholes.

For P3, learners must carry out fieldwork to control level and gradient. They are required to calculate gradients typical for controlling level of works and participate in the fieldwork for at least two tasks which require different standards of accuracy. Examples could include, but are not limited to, the setting out of profiles for drainage, batter rails or profiles for roads. Learners must show their understanding either through questioning by the tutor or by production of a brief report.

For P4, learners must demonstrate an awareness of emerging technology in setting out processes. They must show knowledge of all of the instruments mentioned in the content for learning outcome 4.

To achieve a merit grade learners must meet all of the pass grade criteria **and** the three merit grade criteria.

For M1, learners must carry out volume calculations from survey measurements. The calculations should show cut and fill volumes based on grids of original ground and design levels.

For M2, learners must understand the need for meeting specified accuracies in setting out. Learners must be aware of the appropriate British Standards for construction tolerances.

For M3, learners must specify appropriate instruments and techniques for setting out tasks. They should be able to discuss the application of these instruments to typical setting out tasks including an explanation of how they are used on modern construction projects.

To achieve a distinction grade learners must meet all of the pass and merit grade criteria **and** the two distinction grade criteria.

For D1, learners must analyse procedures in terms of accuracy. They should be able to discuss using the correct terminology, the methods appropriate to at least two setting out tasks where different accuracies are specified.

For D2, learners must assess the advantages of using digital data and new technologies in setting out processes. They should be able to make reasoned judgements about the effectiveness of the new technologies and their appropriateness in terms of cost and site conditions. Learners should also show their understanding of the digital data flow from CAD to setting out.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit provides the skills, knowledge and understanding of basic setting out processes required for learners to progress to more advanced civil engineering courses or to work as setting out engineers. It is assumed that learners have basic skills in surveying as gained in *Unit 10: Surveying in Construction and Civil Engineering*.

This unit may have links to the Edexcel Level 3 Technical and Professional NVQs for Construction and the Built Environment. Updated information on this, and a summary mapping of the unit to the CIC Occupational Standards, is available from Edexcel. See *Annexe D: National Occupational Standards/mapping with NVQs*.

This unit presents opportunities to demonstrate key skills in application of number, communication, information and communication technology, improving own learning and performance, problem solving and working with others. Opportunities for satisfying requirements for Wider Curriculum Mapping are summarised in *Annexe F: Wider curriculum mapping*.

Essential resources

Since this unit is of a very practical nature, centres will require not only a suitable range and quantity of equipment but also suitable areas for carrying out realistic tasks in safety.

As a minimum, the instruments required include tape measures, automatic optical levels and total stations (preferably with on-board data storage) but learners should be made aware of the other instruments mentioned in the unit content and wherever possible should have the opportunity to use them. Suitable ancillary equipment such as staffs, tripods and ranging poles will also be required. There should be sufficient instruments available so that during fieldwork teams will be small in number.

Centres will require access to areas of land with a range of topographic and built features where the surveying practical work can be carried out safely.

Health, safety and welfare issues must be considered at all times and risk assessments undertaken where necessary.

Indicative reading for learners

Textbooks

Bannister A, Raymond S and Baker R – *Surveying, 7th Edition* (Longman, 1998) ISBN 0582302498

Doran D – *Site Engineers Manual* (Whittles Publishing, 2004) ISBN 1870325249

Irvine W and MacLennan F – *Surveying for Construction, 5th Edition* (McGraw-Hill, 2005) ISBN 0077111141

Muskett J – *Site Surveying, 2nd Edition* (Blackwell Science, 1995) ISBN 0632038489

Sadgrove B – *Setting-Out Procedures, 2nd Edition* (Construction Industry Research and Information , 2006) ISBN 0860177076

Uren J and Price W – *Surveying for Engineers, 4th Edition* (Palgrave MacMillan, 2005) ISBN 1403920540

Note: The tutor and learners should be aware that many standard surveying and setting out textbooks are at too high a level, or are too theoretical, for this unit.

Key skills

Achievement of key skills is not a requirement of this qualification but it is encouraged. Suggestions of opportunities for the generation of Level 3 key skill evidence are given here. Tutors should check that learners have produced all the evidence required by part B of the key skills specifications when assessing this evidence. Learners may need to develop additional evidence elsewhere to fully meet the requirements of the key skills specifications.

Application of number Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> carrying out volume calculations from survey measurements. 	<p>N3.1 Plan an activity and get relevant information from relevant sources.</p> <p>N3.2 Use this information to carry out multi-stage calculations to do with:</p> <ul style="list-style-type: none"> a amounts or sizes b scales or proportion c handling statistics d using formulae. <p>N3.3 Interpret the results of your calculations, present your findings and justify your methods.</p>
Communication Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> demonstrating an awareness of emerging technology in setting out processes. 	<p>C3.1a Take part in a group discussion.</p> <p>C3.1b Make a formal presentation of at least eight minutes using an image or other support material.</p> <p>C3.2 Read and synthesise information from at least two documents about the same subject.</p> <p>Each document must be a minimum of 1000 words long.</p> <p>C3.3 Write two different types of documents, each one giving different information about complex subjects.</p> <p>One document must be at least 1000 words long.</p>

Information and communication technology Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> analysing procedures in terms of accuracy. 	<p>ICT3.1 Search for information, using different sources, and multiple search criteria in at least one case.</p> <p>ICT3.2 Enter and develop the information and derive new information.</p> <p>ICT3.3 Present combined information such as text with image, text with number, image with number.</p>
Improving own learning and performance Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> carrying out fieldwork to establish grids of levels and contours over a site. 	<p>LP3.1 Set targets using information from appropriate people and plan how these will be met.</p> <p>LP3.2 Take responsibility for your learning, using your plan to help meet targets and improve your performance.</p> <p>LP3.3 Review progress and establish evidence of your achievements.</p>
Problem solving Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> carrying out fieldwork to control level and gradient. 	<p>PS3.1 Explore a problem and identify different ways of tackling it.</p> <p>PS3.2 Plan and implement at least one way of solving the problem.</p> <p>PS3.3 Check if the problem has been solved and review your approach to problem solving.</p>

Working with others Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> carrying out fieldwork to set out works in plan from coordinates to appropriate accuracies. 	<p>W03.1 Plan work with others.</p> <p>W03.2 Seek to develop co-operation and check progress towards your agreed objectives.</p> <p>W03.3 Review work with others and agree ways of improving collaborative work in the future.</p>